SOURCES AND THRESHOLDS IN THE FISSILE MATERIAL TRANSPARENCY TECHNOLOGY DEMONSTRATION

M. W. Johnson
Los Alamos National Laboratory

The following is intended as amplification of the material presented at the demonstration. The viewgraphs are largely self-explanatory, and the material in them will not be repeated here, except as references. This text, rather, is intended to give some of the rationale for using the sources and thresholds that were chosen, and to provide some insights into choice of possible source materials for authenticating an attributes system developed jointly between the United States and Russian Federation. As in the oral presentation, the comments apply only to the unclassified materials used while the AMS/IB instrument was in its "Open" mode.

Of the thresholds, it may be said that three factors had to be taken into account when choosing numerical values:

- Adherence to US classification requirements (of paramount importance);
- Consistency with previous discussions between the United States and Russian Federation concerning thresholds;
- Capabilities of the AMS/IB instrument.

The first two of these are intuitively clear and need no elaboration. The third deals mainly with the rather artificial threshold used in connection with the Symmetry attribute. As was discussed elsewhere in the demonstration, the NMCC is not optimized for measurement of asymmetries in the neutron field associated with a radiation source inside the NMCC, but rather for performing its original function of coincidence/multiplicity counting. Consequently the NMCC could not be used to perform a full three-dimensional analysis of that neutron field, but could only detect comparatively large deviations from cylindrical symmetry of the field about the axis of the NMCC. Since the main purpose of the FMTTD was to show that sensitive information could be protected, rather than to demonstrate an optimized measurement system, it was thought sufficient for demonstration purposes to use an "asymmetric" source that was contrived to be very asymmetric. The threshold used was therefore chosen after repeated measurements of that source with the AMS/IB, in such a way that that highly asymmetric source would fail the Symmetry test under normal conditions, while the other unclassified samples would pass it.[*] A more satisfactory means of choosing a Symmetry threshold would have to be used in a joint setting where there was crucial information in the Symmetry attribute.

The unclassified sources used were selected so that, for each attribute other than "Presence of Plutonium," at least one source could be measured that would pass each

[*] Note the existence of occasional exceptions for the oxide measurements resulting from settling of the oxide (which, not having been sintered, had no definite, fixed shape) in its container. During the demonstration itself, material handlers took particular care to ensure that the oxide had settled more or less symmetrically about the axis of its container, to aid in the interpretation of the demonstration, but on several occasions during system testing, measurements of the oxide samples did fail the Symmetry test – as they should have.

attribute test, and at least one source could be measured that would fail each test. The matrix at the end of the presentation viewgraphs describes the expected outcomes for each source. As noted in the "Operational Experience" presentation, it was not universally the case that the expected outcomes were indeed observed when measurements were undertaken, sometimes owing to system robustness, sometimes because of inadequacies in the "young" Pu sample that was available, and sometimes because of statistical considerations or real failures of the material to pass the attribute test (the oxide symmetry issue). In planning an eventual joint application involving the Age attribute, it would be valuable to use an authentication sample of "young" material that (1) had been not merely purified of its americium, but created, recently, and (2) is large enough that the weak lines from the ^{241}Pu daughters are statistically significant. Ideally, the authentication sample of young plutonium should be composed of recently-created material that passes the Threshold Mass test, ensuring such statistical sufficiency. However, no such sample was available for use in the FMTTD demonstration, hence the improvised use of a much smaller sample and the statistical problems that resulted.